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of differentiation. It consists fundamentally in the establishment of a relation among living bodies and parts of these such that while the bodies and parts maintain their individuality and identity, they undergo some measure of change. It is that relational action in living bodies which, while producing determinative changes in the bodies, at the same time leaves the individuality of these not only identifiable and unimpaired, but even improved relative to their former states.

This conception firmly grasped may serve as a touchstone, so it seems to me, for testing an enormous range of phenomena of living nature. Not only the whole sweep of purely physical structure and function (the provinces of morphology and physiology), but the great and vastly more vital and appealing realm of human life in its higher reaches (the provinces of psychology, sociology, politics, esthetics, religion, and the rest), can be illuminated by conscientiously applying the criterion. What results from such application in morphology and physiology is exhibited in some detail in Part II, *The Constructive Side of the Organismal Conception* of my book, *The Unity of the Organism*. Systematic application of the criterion lies beyond the purpose of this article. A few illustrations do, however, seem desirable. I shall give three, selecting them from widely separated provinces of the realm of life. These selections will appertain to the relation between parts in the *individual* of higher organisms, to the relation between individuals in the *primary organic groupings of higher organisms*, and to the relation between groups of individuals in *advanced societies* of the human species.

(To be continued)

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DR. RUML'S CRITICISM OF MENTAL TEST METHODS

IN a recent discussion of "the need for an examination of certain hypotheses of mental tests,"¹ Dr. Beardsley Ruml characterizes the results of mental tests as "astonishingly meager in theoretical value," laments the "unproductiveness of the field in propositions of fundamental significance," and criticizes investigators for their failure to find "generalizations of interpretative value in their own material."

This "fruitlessness of the mental test field" and the consequent "waste of scientific talent" is attributed to the persistence of habits of thinking about intelligence which are founded "not upon mani-

¹ This JOURNAL, Vol. XVII, pp. 57-61.

festations of intelligence as we commonly experience them, but upon derivative facts which are the results of measurement by mental tests." "These derivative facts," Dr. Ruml states, "are subject to fundamental bias due to the nature of the terms in which the results of mental test performance have been expressed, and due to the type analysis which our limited and frequently misused statistical technique makes possible." In particular the author specifies as questionable three assumptions into which investigators have been led by a misuse of the derivative facts afforded by mental tests: (1) The assumption that general intelligence can be expressed as a linear or one-dimensional function; (2) the assumption of rectilinear regressions between test performance and general intelligence; and (3) the assumption of a static intelligence level that "does not vary from time to time or from place to place."

1. As to the linearity of general intelligence, it may be questioned whether any one has assumed linearity in the sense in which Dr. Ruml seems to use the term; *i.e.*, in the sense that all intellectual processes are fundamentally of one kind, or in the sense that the intellectual differences among people are adequately expressed simply in terms of more or less of this one hypothetical unitary trait.

No one will dispute Dr. Ruml's statement that Henry may be inferior to Henrietta in certain types of mental processes and superior to her in others, just as a tall man may be "larger" in the vertical dimension than a small man while at the same time "smaller" in the horizontal dimension. Of course we have no warrant for assuming *a priori* that the man who is larger in the vertical dimension is smaller in the horizontal. Quite the contrary, the most reasonable estimate would be one utilizing the positive correlation which exists between the two measurements. Dr. Ruml will admit that such estimates are better than random guesses, but of course a desirable procedure, when possible, is to take both measurements if both are needed in interpretation and if they are likely to differ widely. The hip height of a child is important in assigning seats, but if assignments are upon the basis of total height very little misplacement will result. We take no exception to Dr. Ruml's height-thickness illustration; it is simply a rather poor parallel to most mental situations, as the correlation between mental traits is more likely to resemble that between hip height and total height than that between height and thickness. Spearman could not have made out as good a case as he has for a "single mental function" if the usual correlation between mental traits were not high.

We would urge, along with the hundreds of others engaged in devising special mental tests, that various types of tests be used for

the measurement of various types of mental processes. We would also insist that after applying such tests we are justified in combining them into a single measure if that measure has richer interpretative value than the various measures taken separately. In appraising a mineral deposit, a mining engineer secures samples from various locations and builds up a single total estimate of the mine's value, expressed in terms of a linear dollar and cent scale, even though many different ores may be involved. For certain purposes, such as the buying of machinery, the detailed analysis is necessary. Concepts of aggregates do not preclude recognition of detail.

The Binet scale, for example, not only recognizes the qualitative differences of intelligence at the various levels, but is especially designed to bring into relief what Binet called the hierarchical nature of diverse intelligences.² These "diverse intelligences" range from sensorial intelligence up through perceptual intelligence and representative intelligence to abstract intelligence and judgment. While it is true that in one sense the Binet scale is not a linear measure, it does serve to indicate an individual's position with reference to this hierarchy, and the mental age scores which indicate such positions constitute a scale which, in a special sense, may be regarded as linear.

2. As to the second assumption which Dr. Ruml criticizes, the assumption of rectilinear regressions between intelligence and test performance, it is more nearly in accord with the facts to say that rectilinear regressions have been *found* than to say that they have been *assumed*. Certainly anything else than a reasonably rectilinear regression in mental tests is extraordinarily rare. For example, not a single regression sufficiently non-rectilinear to permit determination of its type was found by one of the authors (Dr. Kelley) in an extended treatment of the results of 22 different serial tests which were tried out with several groups of children and various kinds of criteria in connection with work on the National Intelligence Scale. Dr. Ruml has probably been influenced in his point of view by finding non-rectilinear relationships in trade testing. The building up of a technique for handling problems of this sort merely awaits the need for such. Dr. Ruml has a procedure which he has used for this purpose; one of the writers of this article is shortly to publish another, Charlier has another, and Pearson has several. The non-rectilinear relationships of trade test data are so easily accounted for upon the basis of the acquirement of very specific habits and trade information that they constitute no criticism of the assumption of rectilinearity in the general intelligence field. It is a mere question

² See especially *L'Année Psychologique*, 1905, Vol. 11, pp. 194-195.

of fact whether such relationships are common. Surely, with all the scatter diagrams which have been published by intelligence test investigators in the last ten years, it devolves upon the critic to point to specific situations where material error in conclusion has resulted from the assumption of rectilinearity. The writers do not doubt that there are such, but the really astonishing fact is that they are so few. We of course would urge along with Dr. Ruml that tests for rectilinearity be more commonly resorted to.

3. To the third assumption, that the intelligence level is static, Dr. Ruml opposes the dogmatic assertion that "we know our general mental adaptability to new problems" varies markedly from time to time and from place to place. Perhaps Dr. Ruml "knows" this by intuition, and if so his position can not be questioned by argument. Or has he simply replaced one assumption by another more gratuitous?

In regard to the more fundamental aspect of the entire problem, we would call attention to the fact that the ultimate value of an hypothesis does not depend upon its absolute correctness. On the contrary, some of the most fruitful hypotheses ever given to science have later been shown to be only approximations. Newton formulated a mathematical statement to express the space and force relationships between two masses. The statement has, however, been more than merely interpretative of the specific phenomena in connection with which it was first formulated. It has been tried in new fields—inter-stellar and inter-molecular masses and distances. It has been applied to a sub-molecular matter the very existence of which could not have been apprehended by Newton. What if Newton's laws have broken down? What if Einstein shows that they are only approximations? The service to science has been rendered. Newton's laws were "generalizations of interpretative value in their own material." They were closer approximations to an exact statement than the concepts which they displaced, and in turn will be displaced only by a still closer approximation. Surely Einstein would not claim to have an exact formulation. The Einsteinian, and earlier the Newtonian, statements are mere points of departure. Without Newton as a base there could be no Einsteinian refinement.

This is exactly the situation that obtains in the mental measurement field. The relatively simple and admittedly much less important concept of "constancy of the I Q" may be taken as an example. Future investigation will probably show that this formulation does not rigidly hold, but as a point of departure it has been and still is of great service. Undeniably it will be of value to know

that relatively a child develops mentally more rapidly at certain times and in certain functions than others. But relative to what? Why, of course, relative to that mental feature which is the most stable and characteristic which can be found; with our present state of knowledge, relative to the I Q. The concept of the I Q will not fall as a result of mere verbal attacks, but only when it is experimentally shown not only that it is inconstant, but how it varies. This time will probably come as a result of the work of the very people who have built up the concept. The physicists of to-day are not the ones who object to modifying Newtonian concepts, nor are those most deeply devoted to mental measurement averse to modifying any of the interpretative concepts of the movement. Such concepts as "the constancy of the I Q," "a practical limit to general mental development somewhere in the neighborhood of age 16," "the bearing of mentality upon delinquency and insanity," "the general linear (usually rectilinear) positive correlation between desirable traits," "the great relative importance of individual differences in determining our success in meeting life tasks," "the importance of the intelligence level in fields far removed from the scholastic, as in army assignments," are to be refined, not discarded.

Dr. Ruml seems to advocate a philosophical approach beginning with a definition of terms. We would not withhold encouragement to philosophers who define and thereby help perpetuate valuable concepts, but definition is not the essential genius which leads to discovery. If an experimental procedure reveals that a certain thing is true with reference to a first individual, a second, a third, and many others; if it exists as a phenomenon of human nature and can be measured, then it is entitled to a name and a definition in terms of its experimental setting no matter if it cuts athwart long established concepts.

Dr. Ruml objects to a static intelligence level that does not vary from time to time and place to place. We will not stickle over the term "intelligence level," but assuredly if there is any mental trait which does not vary from time to time and place to place, that is the one of all which it is desirable to know, to measure and to analyze. Life itself, individual, social, biological, physical, may be but a series of divergences from certain constants, but whether this characterizes all of life or not the concept is a most fruitful approach to the scientific understanding of social, biological, and physical relationships. These divergences can only be understood by reference to the constants from which they vary. The zoologist does not measure the belly-band of the blow-toad; he looks for certain skeletal relationships which have scarcely varied in ages. The economist does not

base his view upon the gyrations of a "war-bride"; he goes to great trouble to obtain an index number which is a measure of a more or less constant condition or of a gradual trend. The mental examiner is dealing with the most variable aspect of human nature and it is to be expected that the future mile-stones of progress will be, as those in the past have been, the discovery of traits, capacities, interests, needs or tendencies of an individual which are definitive of him from day to day and place to place.

Thus far Dr. Ruml's criticisms, whether or not one accepts them as valid, at least raise definite issues of a kind which are worthy of critical examination. However, when the author abandons himself to sweeping generalizations regarding the "astonishingly meager value of mental test results," the "great waste of scientific talent," etc., he takes a position we regard as absurdly hypercritical and not demanding an answer.

The history of science shows that direct attacks unhampered by over much or too detailed data upon theoretical problems are usually confined to the early stages of the development of a particular science. In psychology, for example, Aristotle concerned himself with the nature of the soul, psychogenesis, soul biology, and the analysis of temperament; Plato with free will, the seat of the soul, and the soul's origin, nature and destiny; Descartes with the relation between soul and body; Hume, Berkeley and Kant with the origin of ideas and the limits of their validity; Leibnitz with soul energetics; Herbart with mental dynamics and the dethronement of the ego in favor of apperceiving and apperceived ideas; Lotze with the origin and unity of the soul and with the relation between mind and body; Fechner with the search for a mathematical expression of mind-body relationship and with a modified form of soul biology. Gradually as such problems are perceived to be, for the time being, insoluble, among other reasons because of the lack of data, effort is shifted in favor of concentrated attacks upon more immediate problems which serve a purpose in themselves and which may or may not provide a background for further theoretical advance. At this stage the larger issues may even seem to have been lost sight of altogether. A truer statement would be that the young science is girding itself for a new advance. In this connection it is interesting to contrast the methods of Aristotle, Galen, La Mark, Spencer, or Romanes with the minute and painstaking researches of the modern experimental zoologist, physiologist, or comparative psychologist. The infinitesimal minutiae of truth resulting from a typical present-day research would surely seem trivial to an Aristotle, who, in an age when there was no science, did not hesitate to sketch the outlines of

half a dozen sciences. In short, if one loses sight of the essential facts in the historical development of science one is always in danger of demanding that the scientist attempt final explanations of phenomena which available knowledge is not competent to explain.

As Dr. Ruml does not define what he means by "theoretical psychology," "problems of fundamental significance," etc., it is impossible to say in how far he has neglected this aspect of the problem. If by theoretical psychology he refers to problems of fundamental importance to the science of psychology, then the charge that mental testing has been futile may be emphatically denied. A science of human mind can not regard as trivial such problems as individual and racial differences in mental ability, the relationships of mental traits, the phenomena of mental growth, the limitations of educability, or the psychology of genius, mental deficiency and insanity. On all these problems mental tests have thrown light, in some cases more than the entire previous history of psychology. Indeed the mental test method, using the word "test" in the broad sense, has become the most important method of experimental psychology. It is proving itself applicable not only to the problems of intelligence, but also to those of emotion, volition, character, and temperament. It is indispensable in the study of habit formation, mental fatigue, mental inheritance, and animal behavior, while in psychopathology it promises soon to overshadow all other methods. Yet the movement is still in its early infancy.

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REVIEWS AND ABSTRACTS OF LITERATURE

Instinct and the Unconscious: A Contribution to a Biological Theory of the Psycho-neuroses: W. H. R. RIVERS. Cambridge University Press. 1920. Pp. vi+252.

Here is another effect in the field of psychology that is the result of the stimulus of the revolutionary theories of Freud. Rivers's book is an attempt to give to the Freudian theories a biological interpretation; namely, that every animal function is (or *was* in the animal's evolution) of some use. The theory of natural selection says that all parts of the animal developed through their utility. The effort called a "biological interpretation" on the part of some biologists to give an explanation of the use, past or present, of every function is opposed by others (chiefly Loeb and his followers) who maintain that many functions are and have been of no use to the animal. If we agree with the former, then Rivers